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THE NEW ENGLAND BOTANICAL CLUB

Vol. 13. September, 1911. No. 153.

TERATOLOGY IN TRILLIUM OVATUM PURSH.

WALTER DEANE.

(Plate 92.)

THE many instances of teratology in the genus Trillium that are coming to notice more and more as greater attention is paid to this branch of botanical study, and observers are more on the lookout for these forms, seem to show the marked instability in the genus. I have already noted a number of cases (see RHODORA, x. 21–24 and 214–216, 1908 and xii. 163–166, 1910) from New England and New York, and I take great pleasure in recording a most interesting instance in a species from the far west, *Trillium ovatum* Pursh. According to Mr. Charles V. Piper in his Flora of the State of Washington, comprising volume XI. of the Contributions from the United States National Herbarium and bearing the date 1906, the range of the species is "British Columbia to California and Idaho." The type locality is "'On the rapids of the Columbia River.' Collected by Lewis, April 10, 1806, on which date he was at the foot of the Cascades of the Columbia." The flower is white, turning purplish with age.

It is through the courtesy of Mr. W. T. Putnam of Lake Cushman, Washington, a careful observer and an ardent lover of nature, that I am enabled to write the following description. In a letter dated Lake Cushman, Washington, May 24, 1911, Mr. Putnam writes, "A few days ago I found a specimen of the common Trillium of a most beautiful pink and white, not at all the purplish tinge which comes as the flower ages, which had no less than 18 petals. The flower is at present pressing....The root I have." On June 17 I

received the plant carefully pressed, with the rhizome packed in earth in a small box. The latter I turned over to Mr. Robert Cameron of the Harvard Botanic Garden, who planted it in an appropriate place where its development will be watched with much interest. Mr. Putnam sent with the plant a photograph which he calls "A Vine Maple thicket, the setting in which the Trillium was found." The scene in a truly tropical one. The tree is *Acer circinatum* Pursh.

The abnormality in the Trillium is confined to the petals, stamens and pistil. The leaves are normal, in a single whorl of three, rhombic-ovate, and averaging 14 cm. long and 10 cm. broad. The peduncle is 7.5 cm. long and the sepals are narrowly lanceolate, 3.8 cm., 3.7 cm., 3.7 cm. long, and 8 mm. wide.

The petals reach the extraordinary number of twenty-four. Eighteen are in regular alternating whorls of three, the 1st, 3d and 5th and the 2d, 4th and 6th whorls being superposed upon each other. The six petals in the center of the flower form a partially closed cluster, their crumpled and undeveloped character preventing a complete diagnosis of their exact position and shape. The length of the longest one is 1.8 cm., and they apparently alternate with the others in groups of three each in regular order.

I took careful measurements of the first 18 petals. The same order is preserved throughout, the first figures, in whorls 1, 3 and 5 of 3 petals each, referring to the petals superposed upon each other, and so on. The same is true of whorls 2, 4 and 6, and also of the descriptions of the petals. The following is the table of measurements of the petals:

1st whorl, 3.8 cm., 3.8 cm., 3.8 cm. long.
2.3 cm., 2.3 cm., 2.3 cm. broad.
2d whorl, 4.2 cm., 4.2 cm., 4.2 cm. long.
2.7 cm., 2.7 cm., 2.7 cm. broad.
3d whorl, 4.4 cm., 4.2 cm., 4.1 cm. long.
2.5 cm., 2.2 cm., 2.5 cm. broad.
4th whorl, 3.8 cm., 3.8 cm., 3.5 cm. long.
2.0 cm., 2.2 cm., 2.0 cm. broad.
5th whorl, 3.6 cm., 3.4 cm., 3.0 cm. long.
1.8 cm., 1.5 cm., 1.7 cm. broad.
6th whorl, 3.3 cm., 3.1 cm., 3.1 cm. long.
1.9 cm., 1.9 cm., 1.7 cm. broad.

The shape of the petals are as follows:

1st whorl, broadly ovate.
2d " " "
3d " first two slightly ovate, third oblong.
4th " first ovate, second and third obovate.
5th " broadly ovate.
6th " first ovate, second and third oblong.

All the petals are obtuse. There are no stamens or pistil. An interesting accompaniment to the multiplication of petals is, as before related, in the color, the white turning to pink and white, instead of purple. The general resemblance of the flower to that of our beautiful sweet-scented Water Lily, *Castalia odorata* (Ait.) Woodville & Wood, with its many petals, is well shown in the accompanying illustration kindly drawn by Mr. F. Schuyler Mathews. A form of this Water Lily growing mainly near the coast has petals varying from white and pink to pink-red in color.

Turning to the literature dealing with the multiplication of petals in Trillium I find that Prof. F. M. Andrews says in The Plant World for May, 1906, page 101, concerning some plants found near Bloomington, Indiana, "In *Trillium recurvatum* the number of these leaves [floral leaves or petals] in the flowers without reproductive organs was twenty-three, and in *Trillium sessile* fourteen." A specimen of *T. recurvatum* with twenty floral leaves or petals is figured on page 103.

In the Asa Gray Bulletin for February, 1898, pages 18–20, Mrs. W. A. Kellerman tells a most interesting story of a double *Trillium grandiflorum*. The plant was found in the woods of Jefferson County, Ohio. It had thrived, after being transplanted, for ten years, always producing a double flower, when Mrs. Kellerman secured three flowers from the plant. Two she mounted in diagrammatic form, one showing nine, and the other *thirteen* whorls of petals. The latter is figured on page 20.

The late Prof. William R. Dudley in The Cayuga Flora, 1886, page 99, under *Trillium grandiflorum* Salisb. says, "Double-flowered specimens from Woodwardia Swamp Woods, have about 14 parts to the perianth." Instances might be multiplied, but enough have been given to show that this phase of teratology in Trillium is well known in a number of species, but, so far as I have learned, it has not been previously recorded for the northwestern *Trillium ovatum*.

Cambridge, Massachusetts.

A DIMORPHISM IN TIARELLA CORDIFOLIA.

C. H. DANFORTH.

TEN years ago while botanizing in Norway, Maine, the writer was surprised to find two sorts of anthers in *Tiarella cordifolia*. It was noticed at the time that in all the fresh flowers on some plants the anthers were bright yellow while in others they were all of a decided orange color. The two types were quite distinct in this one particular, but apparently identical in every other.

Since 1901 I have regularly observed both forms at Norway, but no further study of them was made until the present season when I examined the anthers and pollen microscopically. The color of the anthers was then found to be due largely or entirely to the contained pollen. The dry pollen grains are elliptical in outline. Those from the yellow anthers are of a clear yellowish green color, those from the orange anthers have a reddish brown tint. When placed in water or weak alcohol they become shorter and somewhat triangular. In a few moments, especially in the alcohol, small droplets of the coloring matter are forced through the wall and collect on the surface giving the grain a tuberculated appearance. The orange pigment is in relatively greater abundance and is more noticeable than the yellow. It is not dissolved by water or weak alcohol, in which the droplets tend to coalesce, but it does mix freely with ether, chloroform, xylol, and strong alcohol.

The anthers retain their color, at least for a time, in pressed plants but in old herbarium material they are badly faded, due it may be to the poisoning agents that have been used. Recently, however, I have received fresh specimens of both forms from Caribou, Maine, Bridgewater, New Hampshire, and Barre, Vermont, which indicates that the variation is of widespread occurrence. The relative abundance of the two forms has not been determined, but it is a personal impression that they are in the proportion of at least two plants with yellow anthers to one with orange.

No traces of mycelium or other evidences of pathological change could be detected in fresh mounts, and both kinds of pollen readily germinated under artificial conditions producing good tubes. Thus it seems very probable that we here have to do with normal plants

involving a marked and clear-cut variation in a single character. Intermediate shades have not yet been found, nor have both colors been seen on the same plant.

The occurrence of this supposed single-character variation indicates that *Tiarella* may be desirable for breeding experiments. The further fact that the two forms are distinguishable by their pollen (which follows a reduction division in the mother cells) suggests that they may be used in cytological and Mendelian studies.

The experience of Dr. Coville with *Epigaea*[1] suggests that with a little care in regard to a few factors many of the wild plants could easily be brought under cultivation and exceptionally good specimens obtained. Moreover there is a sheet of *Tiarella* in the Gray Herbarium bearing a note dated May 11, '86, addressed to Dr. Gray, and signed by M. A. C. Livermore, in which it is stated that the specimens are from a bed of *Tiarella* which originally came from Wilton, New Hampshire. This indicates that the plant had been successfully cultivated in the garden. So there is good reason to expect *Tiarella* to succeed in experimental cultures.

Tufts College, Massachusetts.

A NEW VARIETY OF RUBUS CANADENSIS.

W. H. Blanchard.

Rubus canadensis L. var. **septemfoliolatus**, n. var. Rubus nigrobaccus fruticosus erectus glaber modice elatus, caule tereti aculeis multis brevibus armato, foliis atrovirentibus latis proximis, foliolo terminali saepe in foliola tria sejuncto, deinde foliis 7-foliolatis.

Turiones novi. Caules 9–12 dm. alti, glabri, subteretes, aculeis multis brevibus validis 2 mm. longis, circa 15 ad unciam, armati. Folia 5-foliolata, magna, glabra, atrovirentia; foliola lata breve acuminata, contigua et incubantia, pari inferiore sessili, pari laterali breve petiolulato, foliolo terminali in petiolulo 2.5 cm. longo, latissimo, cordato, saepe lobato vel partito, aut minus saepe in foliola tria diviso.

Turiones veteres. Inflorescentiae plus minusve cymosae aut interdum breve racemosae in ramulis crassis saepe frondosis 7–12 cm.

[1] Coville, Frederick V. The use of acid soil for raising seedlings of the Mayflower, Epigaea repens. Science, N. S., Vol. XXXIII, No. 853, pp. 711–712.

longis. Fructus subglobosi, laxi, magnitudine mediocres. Plantae haud perfecundae.

A glabrous, moderate-sized bush blackberry with dark green foliage, round stem armed with numerous short prickles, and broad close leaves, the middle leaflet frequently divided into three separate leaflets making them 7-foliolate.

New canes. Stems 3 to 4 feet (9 to 12 dm.) high, glabrous, nearly terete, armed with numerous short strong prickles $\frac{1}{12}$ inch (2 mm.) long, about 15 to an inch of stem. Leaves large, broad, dark green, glabrous; leaflets broad, short-pointed, overlapping, lower pair sessile, side pair on short petiolules, middle leaflet on a petiolule 1 inch (2.5 cm.) long, very broad, cordate, often lobed or parted, frequently divided into three leaflets.

Old canes. Inflorescence irregularly cymose or sometimes short-racemose on stout often leafy fruit-branches 3 to 6 inches (7 to 15 cm.) long. Fruit a somewhat globose loose berry of moderate size. Not very productive.

In Newfoundland. Kane Valley five miles west of St. John's in a brook meadow; Norris Arm along the railroad sparingly for a mile; Grand Falls near the paper mill.

The dark green glabrous foliage of this blackberry and the high latitude in which it grows at once indicate that it is a form of *R. canadensis* L., and it is no more strongly armed than is frequent in the far north. It is a larger plant than is to be expected in such a latitude and such surroundings, and it differs greatly from all other forms of *R. canadensis* north or south in the form of its leaves, which resemble in shape and size those of *R. recurvans* Blanchard, having wide leaflets and short petiolules. The cordate middle leaflet is very noticeable and is more so when it is lobed or parted on one side or on both sides, but it is very striking when it is divided into three leaflets as it frequently is.

The plant is normally 5-foliolate; probably one-fourth of the canes, possibly a much greater proportion have some 7-foliolate leaves. This variation in the middle leaflet occurs, though rarely, in some other species, and is generally considered to be a freak, but here it is so common that it may well be considered as a distinctive character. No constant characters can be discovered in the growth on the old canes, and this is the case generally in the extreme northern range of this species. A cymose form of inflorescence is most often seen, and all kinds of oddities occur, but the typical raceme is not found.

I spent the last ten days of August, 1909, in botanizing in Newfoundland, crossing the island twice, a distance of 1100 miles, and explored

as much as the time at my disposal would allow at four places — Bay of Islands on or near the west coast, St. John's on the extreme east coast, and at Norris Arm and Grand Falls between, and I found this blackberry at all of these places except Bay of Islands. But on July 10, 1910, Professors Fernald and Wiegand found at Goose Pond in the valley of the Humber River, seventy miles east of Bay of Islands what appears to be the same form having large flowers with wide petals, but the new canes were not sufficiently advanced to show the expected division of the broad middle leaflet into three.

Blackberries as I expected were not common and the inhabitants seemed to have never seen them. In two cases where persons were sure no such plants existed, I showed them the plants were close by — in one case a few rods from where a farmer was hoeing and in another close to a woman's house.

Westminster, Vermont.

POPULUS VIRGINIANA FOUGER.

Ivar Tidestrom.

In Maryland and Virginia there appear to be two distinct forms of black poplar which are at present referred to *Populus deltoides*. These are a form that is usually cultivated as *P. deltoides* Marsh. and *P. virginiana* Fouger. The former is commonly cultivated but up to the present time I have not been able to find any trees in the wild state, although it appears as if some about Newark, Delaware, might be so. At any rate the identity of *Populus deltoides* Marsh. is uncertain. According to Marshall[1] the tree grows naturally in Carolina and Florida, but his description seems to apply to the trees in Delaware. His description appears to have been taken from "Bartram's Catalogue" and he gives due credit to the latter author. The description reads in part as follows: "The leaves are large, generally nearly triangular, toothed or indented with sharp and deep serrations, of a shining full green on their upper surface, but somewhat lighter or hoary underneath; standing upon long slender foot-stalks, and generally restless or in motion."

[1] Arbustum Americanum, p. 106.

Any one who has travelled in Delaware or portions of Maryland, where poplars are usually found planted about farm houses, might readily have observed these majestic trees with large and spreading branches and broad crowns. Perhaps Marshall described a cultivated tree of his own region, but not knowing its origin, and thinking it the same as Bartram's *P. deltoides*, ascribed it to Carolina and Florida.

Schneider [1] cites *Populus marilandica* Poiret [2] as a synonym of *P. deltoides*. The description, however, is not sufficient to identify the species of Poiret, since nothing is said about the leaves on the new growth, which differ both in form and size from those of the branches. In our concept of species, particularly where we deal with the *Salicaceae*, and for that matter with some groups outside of this family, it is absolutely necessary to take account of the new growth.

In Europe where many of our American poplars have been cultivated for more than a century, traditions have aided in the clearing up of the species and their synonymy. Ascherson and Graebner [3] have two forms, "subspecies," under their aggregate (Gesammtart) *Populus canadensis*. The first appears under this name while the second is held to be *Populus virginiana* Fougeroux. They describe the leaves of *P. canadensis* as follows: "Blätter aus kaum herzförmigem, geradem, oder meist kurz keilförmigem Grunde, breit-eiförmig bis fast rhombisch, zugespitzt, am Rande ziemlich regelmässig gesägt, die unteren der Aeste am Grunde vorgezogen, der Vorsprung am Blattstiel meist einen rechten Winkel bildend, an der Einfügung des Stieles meist mit 2 Drüsen, alle am Rande oder anliegend behaart, an kräftigen Treiben bis über 1 dm. lang und breit." I take this description to apply to the tree which we know as *P. deltoides*. As Ascherson and Graebner state, the leaves are very variable, but usually somewhat rounded at the base, serrate with incurved teeth and acuminate. The larger leaves of the root-shoots, uppermost branchlets, etc., are truncate at the base and acute,— thus somewhat "deltoid." The petioles of both forms are usually equal in length to or longer than the leaf-blade. A good illustration of the ordinary leaf-form is given in Bailey's Cyclopedia **5**: 1410, f. 1913, while the larger form is given under f. 1912. *Populus deltoides* is a pyramidal tree when young but when older, and particularly when free to expand, it be-

[1] Illustr. Handb. Laubh. **1**: 7, 1906.
[2] Lam. Enc. Suppl. **4**: 378, 1816.
[3] Syn. Mitteleurop. Flora **4**: 33, 1908.

comes a larger tree with spreading branches. (The same statement might be made with respect to other species of Populus, except *Populus nigra italica* and *P. alba Bolleana* which are naturally fastigiate forms.) I have only seen staminate trees of *P. deltoides* in our region. The aments are well illustrated in Professor Sargent's magnificent work.[1] The anthers are described as being red, which statement agrees with my observations. In or about Washington the trees flowered this year about April 7, two weeks later than in ordinary seasons.

The other "subspecies" of Ascherson and Graebner's treatment, is apparently native of this region. Its entire range is unknown at present. Typical leaves of this species are illustrated by Schneider under *P. monilifera*, from which it may not differ in any particular except possibly in varietal characters. It was only upon the authority of the early botanists that I ventured[2] to identify our native tree with *P. virginiana* Fougeroux. If any species is entitled to this name it is certainly this one, which is the only apparently native black poplar of Virginia. It is readily recognized by its leaves. These are almost always somewhat cordate. (See the text figure.) Not only in the form of the leaves do the two species differ. Their flowering seasons are about two weeks apart in our region. Another feature is that the anthers in *P. virginiana* are yellow, while in *P. deltoides*, as stated above, they are red.

Fig 1. Populus virginiana. Leaf × ½, showing characteristic form of base.

Populus virginiana flowered this year about April 20, just thirteen days after *P. deltoides*, and it was indeed a pleasant sight to see the golden aments. The trees from which I collected my specimens

[1] Silva of N. Am. **9**: 179.
[2] Elysium Marianum **3**: 16, t. 3, f. B, 1910.

(No. 4475) are located near the Glen Echo lock of the Chesapeake and Ohio canal along the Potomac River. They are the very trees upon which the record of *Aigeiros virginiana* in Maryland was based. At the time I re-established this species I had never seen the tree in flower. Since that time my friend, Mr. Bartlett, has observed a number of trees along the Virginia shore of the Potomac River, some ten miles above Washington.

A synopsis of our black poplars and their synonymy may be given as follows:

Leaves of a cordate type.

Populus virginiana Fouger. Mem. Soc. Agr. Par. 1786: 87, 1787.

P. nigra β *virginiana* Castigl. Viaggio negli Stati Uniti **2**: 334, 1790.

P. monilifera Ait. Hort. Kew. **3**: 406, 1789?

Michx. f. Hist. Arb. **3**: 295, t. 10, f. 2, 1813.

Watson, Dendr. Brit. **2**: t. 102, 1825 (typical leaves).

Schneider, l. c. f. 1: a–c, f. 3; n–n^2.

Aigeiros virginiana Tm. Elys. Mar. **3**: 16, t. 3, f. B. 1910.

Virginian Black Poplar.

Pyramidal (when young), with spreading stout branches and a broad crown (when old): bark ashy-gray with a tinge of yellow; branchlets olive-colored or light-brown; buds light-brown, acuminate, scales ovate with a whitish margin, mucronate; leaves on somewhat reddish petioles, mostly cordate (1 dm. in length and fully as broad) acuminate, glabrous or nearly so on the upper face, sparingly pubescent on the lower face, *margins pubescent*, crenate-serrate from within 2 cm. on each side of the petiole to within the same distance of the apex; staminate aments 1 dm. or less in length, scales laciniate, caducous; flowers on pedicles 5 mm. more or less in length; stamens about 30 in number, anthers yellow; fruiting aments 1 dm. or more in length.

In *P. virginiana* the leaf-margin on each side of the petiole is nearly straight and entire: where it meets the petiole it forms an angle of about 120°, as shown in the illustration.

Castiglioni (l. c.) held the Virginian poplar to be a variety of the black poplar of Europe, possibly on account of the dark green color of the leaves. That he regarded it identical with *Populus virginiana* Fouger. is evident from the following extract:

"Così il Pioppo nero della *Virginia* (*Spec.* I. *var.* β) sembrami una varietà del Pioppo nero d'Europa, benchè il Sig. *Fougeroux de Bondaroy* nelle Memorie della Società d'Agricoltura, che si stampano a Parigi, ne formi una nuova specie. Quest' albero s'innalza a settanta, ed ottanta piedi formando una cima rotonda, le sue foglie sono sostenute da lunghi picciuoli spesso tinti di rosso, e sono quasi a figura di cuore, scannellate al margine, e liscie da ambe le parti . . . ."

Leaves of an ovate type.

Populus deltoides Bartr., Marsh. l. c.?

P. canadensis Moench, Weisenst. 81, 1785; Asch. & Graebn. Syn. **4**: 33, 1908.

? P. marilandica Bosc; Poir. in Lam. Enc. Suppl. **4**: 375, 1816.

Aigeiros deltoides Tm. l. c.

Similar in stature and form to the preceding: branchlets smooth, yellowish-brown: buds dark olive-brown, pointed; normal leaves 8–10 cm. in length, deltoid-ovate, base rounded; crenate-serrate to within 1 cm. of the apex; leaves of the root-shoots and uppermost branchlets 15 cm., more or less, in length, and as wide, base truncate: staminate aments about 1 dm. in length; stamens about 40, anthers dark red.

It is to be hoped that local botanists will take up the study of their native poplars so that we may know at least as much about our trees as is known in Europe. Concepts based on herbarium specimens alone often tend more to confuse than illuminate.

Bureau of Plant Industry, Washington, D. C.

ON GYNODIOECISM IN PLANTAGO LANCEOLATA.

Harley Harris Bartlett.

In 1879 Franz Ludwig[1] published an account of the forms of the flower in *Plantago lanceolata*, in connection with a general discussion

[1] F. Ludwig: Ueber die Blütenformen von *Plantago lanceolata* L. und die Erscheinung der Gynodiöcie. Zeitschr. für die gesammten Naturwissenschaften, lii (1879), p. 441. Review in Bot. Centralb. i (1880), p. 331.

of gynodioecism. He called attention to the observation by Darwin [1] that in England there were two kinds of stocks of *Plantago lanceolata*, of which one had perfect and the other pistillate flowers. The flowers of the pistillate stocks did, indeed, bear anthers, but there was either no pollen at all or only a few imperfect grains of varying size. According to a communication from Delpino to Ludwig, there were in Italy three geographic varieties of *P. lanceolata*, of which one only, the early spring form of the meadows, was dimorphous. One form had broad white anthers with an abundance of pollen; the other broad green-yellow anthers with scanty pollen but regular dehiscence, still an hermaphrodite form, but verging toward the gynodioecious condition. In Germany, Ludwig himself found that all the habitat and geographic variations exhibited three flower forms: 1) the ordinary hermaphrodite, with long straight filaments bearing broad, roundish to heart-shaped white anthers containing plentiful pollen, 2) a form with short, crooked filaments bearing slender, green to sulphur-yellow irregularly dehiscent anthers, with abortive pollen, and 3) a purely pistillate form with no filaments and very small rudimentary yellow-green or brownish anthers. He thought that the second of these forms was identical with Darwin's "female form," but the descriptions do not agree well enough to establish their identity beyond question.

With regard to the relative frequency of the forms, Ludwig found that in general the second was much scarcer than the first, and that the third was much more infrequent than the second. He observed that the pistillate form was characterized by extreme fertility, whereas

[1] Darwin's own statement (Forms of Flowers, ed. 2, pp. 306-307) is as follows: "....But I have found in two localities in England female and hermaphrodite forms existing together, and the same fact has been noticed by others. (Mr. C. W. Crocker in 'The Gardener's Chronicle,' 1864, p. 294. Mr. W. Marshall writes to me to the same effect from Ely.) The females are less frequent than the hermaphrodites; their stamens are short, and their anthers, which are of a brighter green while young than those of the other form, dehisce properly, yet contain either no pollen, or a small amount of imperfect grains of variable size. All the flower heads on a plant belong to the same form. It is well known that this species is strongly proterogynous, and I found that the protruding stigmas of both the hermaphrodite and female flowers were penetrated by pollen tubes, whilst their own anthers were immature, and had not escaped out of the bud. *Plantago media* does not present two forms; but it appears from Asa Gray's description ('Manual of the Botany of the N. United States,' 2nd. edit. 1856, p. 269. See also 'American Journal of Science,' Nov. 1862, p. 419, and 'Proc. American Academy of Science,' Oct. 14, 1862, p. 53.) that such is the case with four of the North American species. The corolla does not properly expand in the short-stamened form of these plants."

the common hermaphrodite form often failed to produce seed. Another character which distinguished the intermediate and pistillate forms from the hermaphrodite was that the former produced greatly elongated stigmas far more frequently than the latter. This seemed to be due in part to the continued growth of the stigmas in pistillate plants whose pollination was delayed beyond the time at which a normal hermaphrodite would have been self-pollinated. In part, however, it seemed to be an inherited tendency of the pistillate stocks.

A. Schulz [1] established the fact that *Plantago lanceolata* is not only gynodioecious but also gynomonoecious. The flower spikes of gynomonoecious stocks bear both hermaphrodite and pistillate flowers, and intermediate types, in separate zones or variously intermingled.

The writer's attention was brought to the forms of *Plantago lanceolata* in the summer of 1910 through finding in his experiment garden at Bethesda, Maryland, a single plant with bright yellow sagittate anthers. This plant was unique, for an examination of thousands of specimens of the species in the surrounding fields failed at the time to disclose another like it. However, the search brought to light many purely pistillate plants, which formed no inconsiderable proportion of the total number, and a great variety of gynomonoecious forms. At the time the yellow-anthered form was found, the Plantago had been in flower only a short time. Since then the greater part of the season of 1910 and the season of 1911 have passed without more than a half dozen such specimens having been found. Many times an identical anther form has been found on gynomonoecious stocks which were nearing the close of their season, and flowering only at the top of the spikes. Such plants never failed to show, however, the wilted remnants of broad white anthers like those of the pure hermaphrodite form.

For convenience the three chief forms of *Plantago lanceolata* which have been found about Washington will be called, in the remainder of this paper, the 1st and 2d form hermaphrodites and the pistillate form. They correspond to the three forms distinguished by Ludwig, although their numerical distribution is not the same here as in Germany. (It will be remembered that Ludwig found his intermediate form much more abundant than the pure pistillate.

[1] A. Schulz: Beiträge zur Kenntniss der Bestäubungeinrichtungen und Geschlechtsverteilung bei den Pflanzen. Biblioth. Bot., Heft 10 (1888) p. 90.

Fig. 1. Plantago lanceolata. Flower of 1st form hermaphrodite.

1st Form Hermaphrodite. This is the form shown in fig. 1. Typically the filaments are about four times as long as the stigma. The anthers are white, and twice as long as broad. The pollen is very abundant.

2d Form Hermaphrodite. A flower from the plant found at Bethesda, Md., is shown in fig. 2. The filaments and style are of equal length, and about half as long as the filaments of the 1st form. The anthers are four times as long as broad, and yellow. The pollen is more scanty than in the 1st form, and, on account of the irregular dehiscence of the contabescent anthers, is not usually liberated. Pollen grains of uniform size, diameter half as great as in the 1st form.

Pistillate Form. Shown in fig. 3. Filaments so short that the abortive, brownish anthers are hardly or not at all exserted. Stigma usually longer than in the 2d form hermaphrodites.

Fig. 2. Plantago lanceolata. Flower of 2nd form hermaphrodite.

Pistillate forms vary greatly in the extent to which the stamens are developed. Some of them differ from the 2d form hermaphrodite only in the fact that the anthers are greener, and contain no pollen. In others the stamens are represented only by minute scales. In some pistillate types very few of the flowers ever open. The stigmas are extruded as usual, but the perianth never expands. In others the flowers open in the normal way.

Both the 2d form hermaphrodite and the pistillate form show much variation in the length of the stigma. When the original plant of the 2d form hermaphrodite was found, its stigmas

were exceedingly long and plumose, so that the spikes looked like bearded wheat. This extreme condition was temporary, however, for as soon as the 1st form hermaphrodites in the fields commenced to yield plenty of pollen, the stigmas did not grow so long. Yet the character of long stigmas is by no means altogether circumstantial. It is often seen in pistillate plants which are growing in colonies where pollen is abundantly available. It may likewise be shown to occur rarely in the 1st form hermaphrodite, and more commonly in the gynomonoecious types, by examining the length which the stigmas attain before the lowermost flowers of a spike mature their stamens. On the other hand, pistillate types occur in which the stigmas are very short indeed. The long- or short-stigma character may occur in combination with any set of stamen characters.

All the seed matured by the original plant of the 2d form hermaphrodite found in 1910 were saved and planted. No effort was made to guard pollination. Doubtless the stigmas were pollinated by the 1st form hermaphrodite, for the plumose styles of one spike were examined and found to be amply supplied with the large pollen of the 1st form while the anthers of the 2d form were drying up without having dehisced.

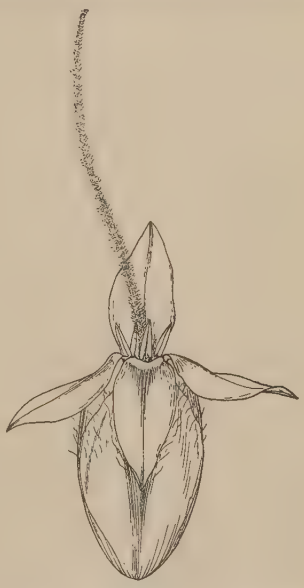

Fig. 3. Plantago lanceolata. Flower of pistillate form.

The seed were planted in four lots:

1st lot. 25 seeds from the first three spikes to mature, planted in August in unsterilized garden soil taken from below the surface. Plants 1 to 9.

2d lot. Seed from the last three spikes to mature. If there were any self-pollinated seed (which is very improbable) they would have been in this lot, for at the time the spikes flowered the mother plant was isolated in the green-house, and there were very few plants in bloom out doors. Planted in October in clean white sand.—17 plants, nos. 10 to 26.

3d lot. Seed from spikes which flowered in the garden during the

height of the season. Planted in December in sterilized soil.— 45 plants, nos. 27 to 71.

4th lot. Remaining seed from the first three spikes, planted in February in sterilized soil.— 66 plants, nos. 72 to 137.

The first three lots were twice repotted, and were never set out in the garden. The fourth lot were set out in the garden early in the spring. Details of the planting are recorded because some of the plants will be grown another generation, and reported upon next year. The results of growing the first generation are chiefly of interest in that they show how the characters of such a derivative as the 2d form hermaphrodite might maintain themselves in nature, without isolation or selection.

The progeny were readily classified, with a few exceptions which will be discussed later, as typical hermaphrodites of the 1st and 2d forms. The numbers of the two types were as follows:

Lot	1st Form.	2d Form.	Unclassified	Total.
I.	6	2	1	9
II.	7	10	0	17
III.	17	20	8	45
IV.	21	41	4	66
All.	51	73	13	137

None of the plants classified as 1st and 2d form hermaphrodites showed any marked deviation in anther character from the types illustrated in figs. 1 and 2. There were, however, several plants among those called 2d form which had the typical anthers of this form but long filaments, and one plant with unusually green anthers. These will be grown for another generation. The 13 unclassified plants included 7 which formed vigorous rosettes, but did not flower, and 6 with short rounded spikes. The mother plant had long spikes (var. *alopecurodes* F. Ludwig). Short-spiked plants of *Plantago lanceolata* have been set off as a variety (var. *sphaerostachya* DC.) which is not generally maintained as valid, for most systematists would probably regard it, *a priori*, as a mere ecological state. In my cultures, however, a short-spiked variety was sharply set off from a long-spiked variety, although both were grown under identical conditions. The short-spiked plants had some white stamens, but could

not be classed with the 1st form hermaphrodites on account of their strong gynomonoecious tendency.

In vegetative characters the culture showed extreme diversity. One plant was the most narrow-leaved specimen of the species which the writer has thus far seen. Other plants showed almost maximum leaf breadth. (The mother was rather narrow-leaved.) In some of the progeny the leaves were prominently serrate, in others nearly entire. In pubescence, length of stigmas, shape of perianth parts, and development of anthocyanin there was no uniformity. There seemed to be no correlation of these characters with one another, except that perhaps narrow leaves were usually correlated with narrow perianth parts, and that 2d form hermaphrodites were never very broad-leaved. On the other hand, many narrow-leaved plants, including the exceptional one mentioned above, were of the 1st form.

Seed from a purely pistillate plant of *Plantago lanceolata* were also harvested in the fall of 1910 and planted in a cold frame in sterilized soil. Unfortunately there was no room to pot the young plants, so that when they became over-crowded they had to be set out in the garden directly from the seed pans. A late frost destroyed all but a few of four hundred plants. The remainder, in bloom, were either like the mother (purely pistillate) or the usual 1st form hermaphrodite. The numbers of each type were not counted, however. The culture will be repeated next year.

Correns has made a study of heredity in many gynodioecious plants. In those of his papers [1] which deal with *Plantago lanceolata* he has reported on the progeny of 28 plants whose pollination was unguarded, and four plants whose pollination was guarded. All of his mother plants seem to fall into the following categories: 1) pure 1st form hermaphrodites, 2) gynomonoecious types with a) some functional stamens, or b) all of the anthers contabescent, and 3) purely pistillate types. His tabulated results show that the progeny of all except certain of the pure hermaphrodite stocks included pure pistillates, and even in the case of one of the pure hermaphrodites, the pure pistillates amounted to 50%. Since in counting pure pistillate stocks,

[1] Correns: Die Vererbung der Geschlechtsformen bei den gynodiöcischen Pflanzen. Ber. d. deutsch. bot. Ges. xxiv (1906) pp. 459–474.

—— Zur Kenntnis der Geschlechtsformen polygamer Blütenpflanzen und ihrer Beeinflussbarkeit. Jahrb. f. wiss. Bot. xliv (1907) pp. 124–173.

—— Die Rolle der männlichen Keimzellen bei der Geschlechtsbestimmung der gynodiöcischen Pflanzen. Ber. d. deutsch. bot. Ges. xxvi a (1908) pp. 683–701.

Correns excluded all plants with contabescent anthers,[1] it is of interest that the 2d form hermaphrodite, with contabescent anthers only, should (with one possible exception) give no progeny more closely approximating the pistillate form than itself. It is furthermore noteworthy that there should be 2d form hermaphrodites among the progeny with typical anthers but with filaments long and straight, as in the 1st form, and that these should have but one type of flower, (i. e. should show no tendency toward gynomonoecism.)

Neither out-door observations of wild plants nor garden and greenhouse cultures sustain Ludwig's statement that the pistillate plants of *Plantago lanceolata* flower later in the season than the hermaphrodites. After the height of the flowering season has passed, pistillate stocks seem unusually abundant because the continued growth of the unpollinated stigmas makes them unusually conspicuous. Then too, gynomonoecious types often have only pistillate flowers at the tops of the spikes, and late in the season might be carelessly classified as pure pistillates.

Bureau of Plant Industry, Washington, D. C.

The Range of the Black Birch to be restricted.— In all the manuals of botany and tree books where it is treated we are assured that the black birch, *Betula lenta*, often called the sweet birch and cherry birch, ranges east to Newfoundland. But in fact its eastern limit is close to the eastern boundary of New Hampshire, and a line drawn from Portland, Maine, to Montreal will mark its eastern and northern limit at least in the United States. The only places in Maine where I have seen it are in the Piscataqua valley, and the only specimens I have seen from Maine grew there. Specimens labeled as black birch are found from places farther east but the most cursory examination shows them to be incorrectly named. I have botanized in all of the Maritime Provinces and in Newfoundland, and found as I expected that there was no such tree there.

The provincial botanists having never seen the real black birch think that when they find a yellow birch (*B. lutea* L.) with black bark

[1] "Rein gefüllt blühende Stöcke, bei denen die Staubgefässe in Füllblätter verwandelt sind, sind [als rein weibliche Pflanzen] eingerechnet, solche mit lauter kontabeszenten Antheren jedoch nicht, obwohl sie physiologisch auch rein weiblich sind." Ber. d. d. bot. Ges. xxvi a (1908) p. 691.

they have found a black birch, and lumbermen everywhere from the Adirondacks to New Brunswick are sure that they have two birches which they are loth to believe can be age variations only. With them it is a gray or silver birch when the bark on the trunks can be removed like that on the paper birch, but when the back is furrowed with age it is another kind; and it must be admitted that in this case there is little about the bark of a large log to indicate its relationship with a young tree of the same species. There is no commercial distinction, at least in the north, between the timber of the black and yellow birch, and birch floors are invariably called cherry birch floors but are usually if not always made of yellow birch. In fact the black birch in New England never grows to a size suitable for using in anything except in small dimensions such as chair-stuff, baby-wagon spokes, etc. The black birch is hardly a northern tree and the area covered by it in Vermont and New Hampshire is quite limited. It grows in Western Vermont and is frequent in Burlington; and it is found in the lower valleys of the Connecticut and Merrimack and in southeastern New Hampshire. Its range in the provinces of Quebec and Ontario I do not know, but it is abundant at and about Ottawa. Its range as well as its abundance in Michigan, Wisconsin, Minnesota, and Iowa is unknown. In short the two birches *B. lenta* and *B. lutea* have been so confounded by lumbermen and botanists that no dependence whatever can be placed on any published statement as to either range or frequency of the black birch in the north, northeast or northwest.— W. H. Blanchard, Westminster, Vermont.

Arrhenatherum elatius β tuberosum in America.— In a recent number of Rhodora (vol. 13, p. 9, Jan., 1911) the writer described and figured the subterranean organs of a grass supposed to be *Cinna arundinacea* L. During the past spring a number of specimens of these clustered corms were sent to the Department of Agriculture from various stations on the southern Atlantic coastal plain. The frequency with which these were received suggested some recently introduced species. Mr. Cooper of Decatur, Georgia, who first sent the puzzling underground organs was asked to send flowering specimens. This he kindly did, and the plant is found to be *Arrhenatherum elatius β tuberosum* (Gilib.) Halac. (*Avena tuberosa*

Gilib., 1791; *Avena bulbosa* Willd., 1799; *Holcus bulbosus* Schrad.; *Arrhenatherum bulbosum* Presl; *Avena elatior* var. *tuberosa* Aschers.) This common European species appears to be a recent immigrant. There is no record of its appearance in this country earlier than October, 1910, when the first specimen was received from Mr. Cooper. As yet the only specimens received from the Manual region are from King George, Caroline and Chesterfield counties, Virginia. The variety differs from *Arrhenatherum elatius* chiefly in production of clusters of moniliform corms. The spikelets are similar to those of the species but the hairs at the base of the florets are shorter and the second floret is awned. In the species the second floret is usually awnless but sometimes bears a short awn.

Cinna arundinacea has not been found with the clusters of moniliform corms. Late fall specimens show a single basal internode thickened and corm like, as in *Phleum pratense* but much more developed.— Agnes Chase.

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